

Heat of Fusion and Heat of Vaporization Calculations

Examples:

- 1) How much heat is required to melt 360g of solid water?

$$H_{\text{fusion}} = 334 \text{ J/g}$$

$$\begin{aligned} Q &= m H_f \\ &= (360 \text{ g}) (334 \frac{\text{J}}{\text{g}}) \\ Q &= 1.2 \times 10^5 \text{ J} \end{aligned}$$

- 2) How much heat is released when 105g of steam condense to liquid water?
- $$H_{\text{vap}} \text{ of water} = 2257 \text{ J/g}$$

$$Q = -m H_v$$

$$= - (105g) \left(\frac{2257J}{g} \right)$$

$$Q = -2.4 \times 10^5 J$$

Heating Curves

Example: A 0.085kg sample of mercury is heated from 25 ° C to 500 ° C.

a) Sketch the heating curve, label T_i , T_f , MP, BP

$$c(\text{solid}) = 0.142 \text{ kJ/kg} \cdot ^\circ \text{C}$$

$$\text{MP} = -39^\circ \text{C}$$

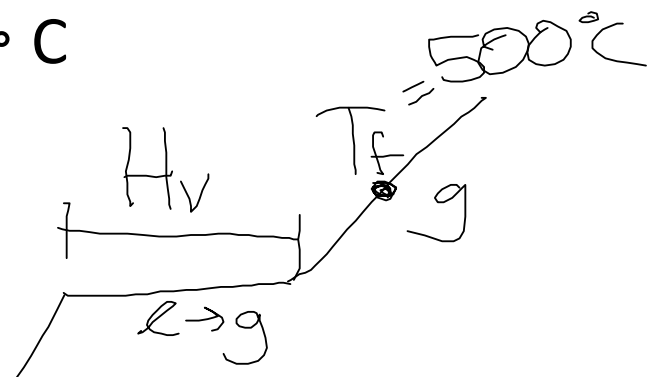
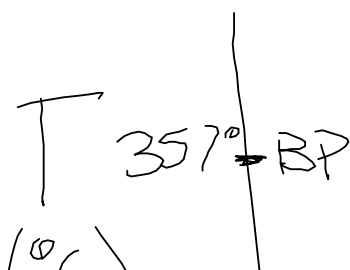
$$\text{Heat of fusion} = 11.3 \text{ kJ/kg}$$

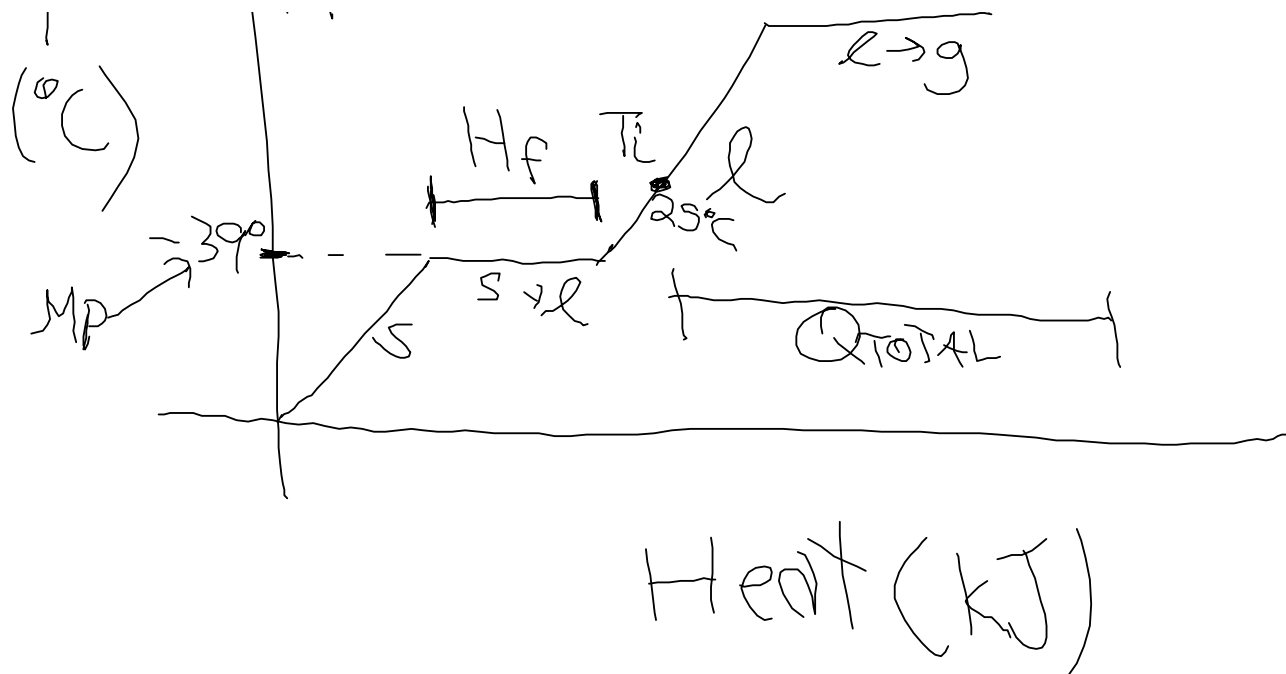
$$c(\text{liquid}) = 0.140 \text{ kJ/kg} \cdot ^\circ \text{C}$$

$$\text{BP} = 357^\circ \text{C}$$

$$H_{\text{vap}} = 293 \text{ kJ/kg}$$

$$c(\text{gas}) = 0.104 \text{ kJ/kg} \cdot ^\circ \text{C}$$





Calculate the heat required for each step of this heating process.

$$\underline{25^{\circ}\text{C} \rightarrow 39^{\circ}\text{C}}$$

$$Q = mc\Delta T$$

$$= (.085\text{kg})(0.140\frac{\text{kJ}}{\text{kg}^{\circ}\text{C}})(332^{\circ}\text{C})$$

$$Q = 3.95\text{kJ}$$

$$\underline{H_{\text{vap}}}$$

$$Q = mH_v$$

$$= (.085\text{kg})(293\frac{\text{kJ}}{\text{kg}})$$

$$Q = 24.9\text{kJ}$$

$$\underline{357^{\circ}\text{C} \rightarrow 500^{\circ}\text{C}}$$

$$Q = mc\Delta T$$

$$= (.085\text{kg}) \left(\frac{0.104\text{kJ}}{\text{kg}^{\circ}\text{C}} \right) (143^{\circ}\text{C})$$

$$Q = 1.26\text{kJ}$$

$$Q_{\text{TOTAL}} \approx 3.95 + 24.9 + 1.26$$

$$Q_T = 30.1\text{kJ}$$